



Project courtesy of Imoto Lines, Ltd. and Kyokuyo Shipyard Corporation

Utilization of OCX as part of 3D Model Based Approval in ship design process

Tapio Seppälä
Product Owner, NAPA Steel

napa.fi

Overview

Introduction

Rule Scantling Iteration in CAD

OCX Import / Further Utilizations for 3D MBA

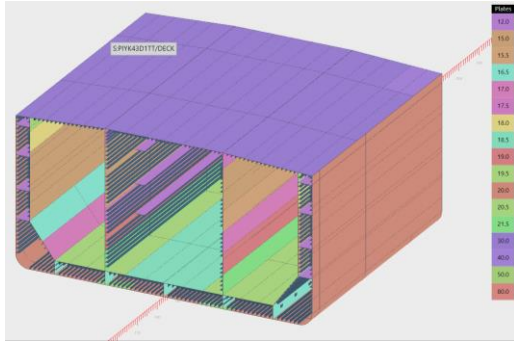
Q&A



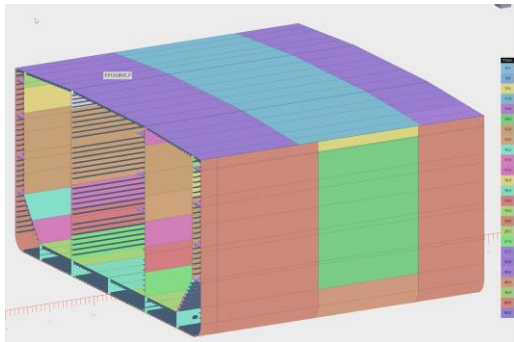


Rule Scantling Iteration in CAD

Conventional rule scantling (2dlx format)



NAPA Designer – Steel 3D model
(Before rule check)



NAPA Designer – Steel 3D model
(after rule check)

Export cross-sections
(2dlx format)



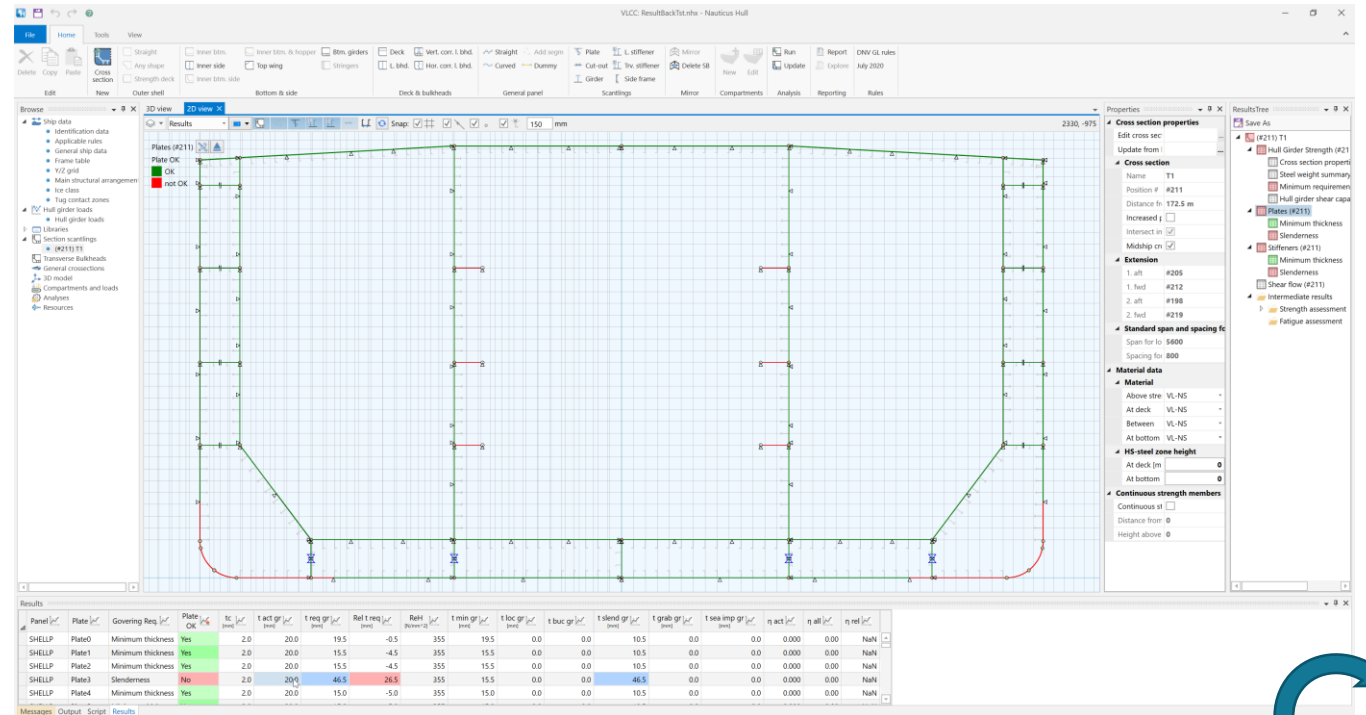
Export compartments data
(.csv)



Manual update 3D
model scantling



Update with
2dlx+Napa Script



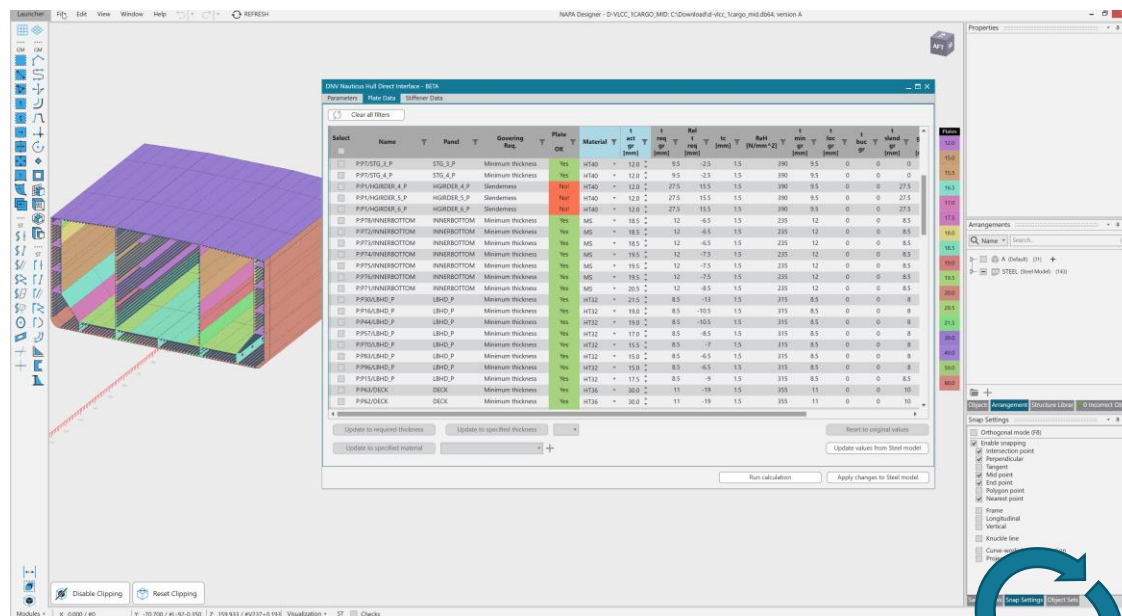
DNV Nauticus Hull – Workspace
(general info, rule, hull girder loads, compartment manual mapping for section)



Scantling
Changes+Run



NAPA-DNV Nauticus Hull direct interface



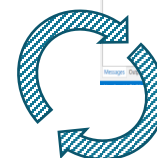
NAPA Designer – Steel 3D model

**Scantling
Changes+Run**

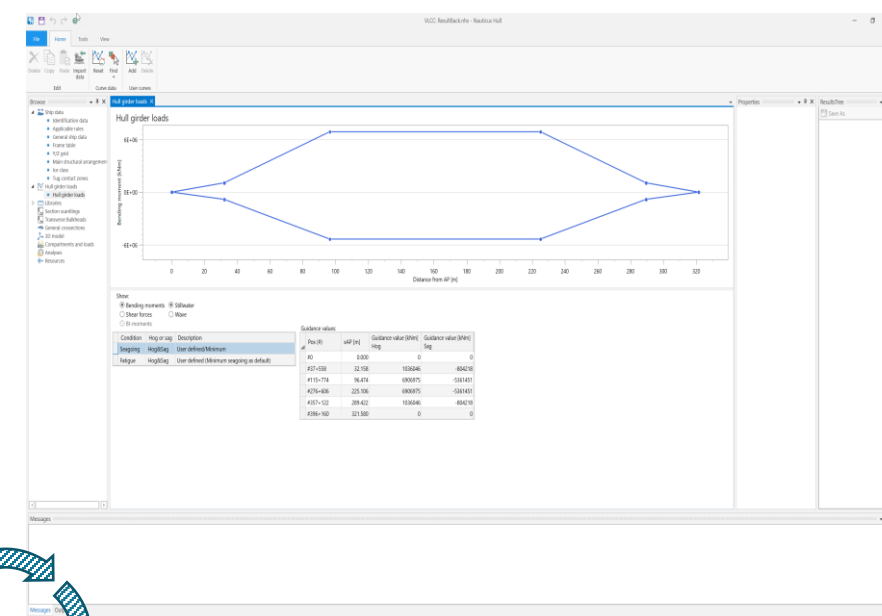
**3D Model
(OCX)
Section and
setting(.js)**



Result
(xml)



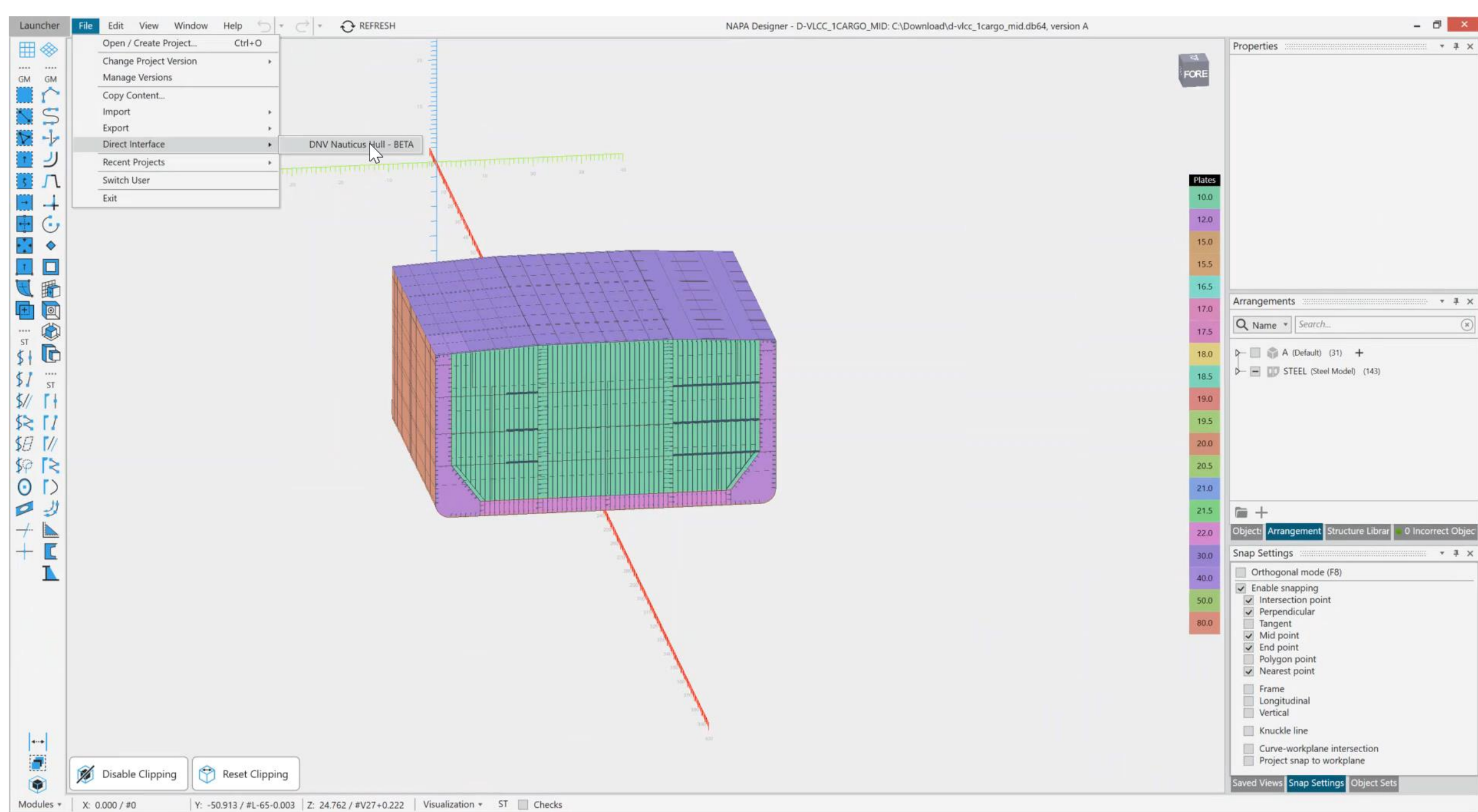
Background
Rule check



DNV Nauticus Hull – Workspace

(general info, rule, hull girder loads, compartments)

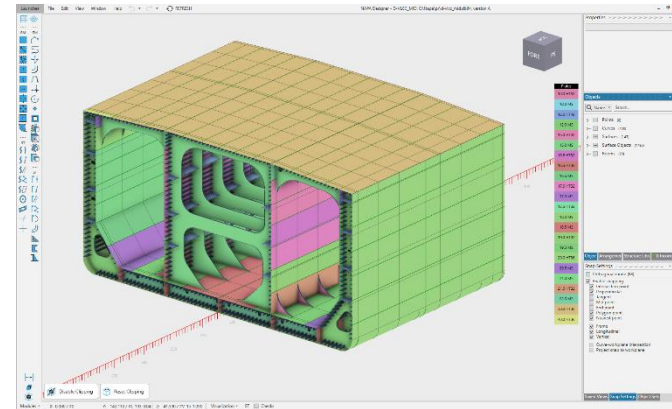
- ✓ Rule calculation in NAPA Designer based on DNV Nauticus Hull
- ✓ Design iteration of scantling can be possible without leaving NAPA Designer until it satisfies the rule requirement



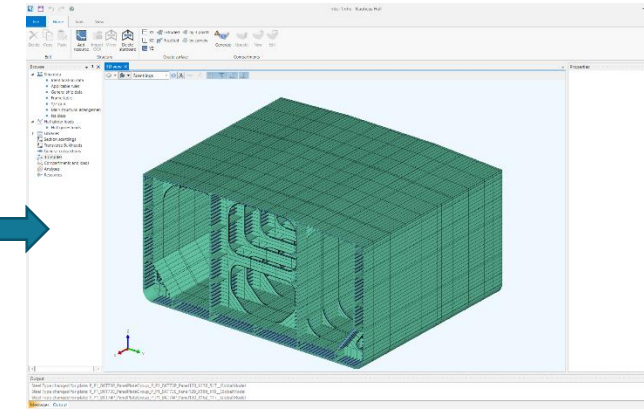
OCX as ship structural 3D model transfer

- **NAPA Designer: OCX export**

- ✓ Panels, stiffener, plates, bracket, pillars
- ✓ Catalogue: material, profiles, hole
- ✓ Principal particulars and frame systems
- ✓ Compartments, mapping of purpose
- ✓ Mapping structure types to OCX function types
- ✓ End connections of stiffeners
- ✓ Units
- ✓ **Update file with the changed properties only**
- ✓ Export **only limited by clipping box** (Efficiency in data transfer)
- ✓ GUID synchronization btw OCX in the same project (Revision control)



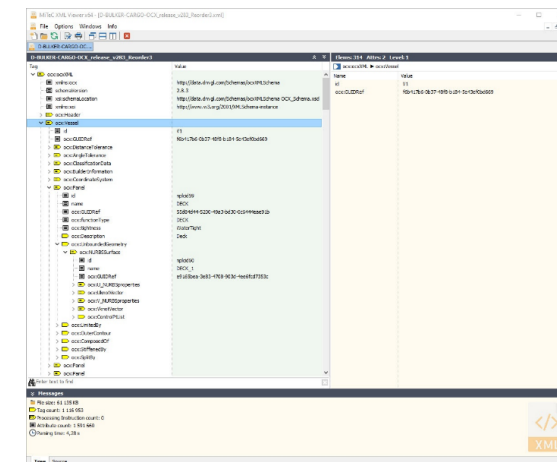
NAPA Designer



DNV Nauticus Hull

- **DNV Nauticus Hull: OCX import**

- ✓ Reconstruct 3D structural model
- ✓ Import all relevant general information
- ✓ **Capability to create cross-sectional model**
- ✓ To export local scantling result with original ID in OCX file



OCX File (3DOCX; Xml)

OCX as ship structural 3D model transfer

The screenshot displays the Nauticus Hull software interface, version 20.0 - DevOps version. The main window shows a 3D view of a ship hull structure, with a 2D view option also available. The interface includes a top menu bar with File, Home, Tools, and View. Below this is a toolbar with various icons for editing, structure, and analysis. The left sidebar contains a 'Browse' panel with a tree view of the model's hierarchy, including Ship data, Hull girder loads, Libraries, and Resources. The right sidebar shows a 'Properties' panel. A 'Clipping planes' dialog box is open in the foreground, allowing users to define clipping planes for the 3D model. The bottom status bar displays the current view (2D view) and the number of messages (177). The bottom right corner features a circular logo with the letters 'NAPPA'.

File Home Tools View

Delete Copy Paste Add resource Import OCN Mirror Delete starboard

Edit Structure Create surface Plates Stiffeners Compartments Cross section analysis Reporting Rules

XY Extruded by 3-points 2D Seam 2D Stiffener Generate Update New Edit Preview Run Report DNV rules July 2022
XZ Facetted by corners 3D Seam 3D Stiffener Update Explore
YZ Plate Propose stiffener

Browse Ship data Identification data Applicable rules General ship data Frame table Y/Z grid Main structural arrangement Ice class Tug contact zones Hull girder loads Hull girder loads Libraries Section scantlings Transverse Bulkheads General crossections 3D model Compartments and loads Analyses Resources

2D view 3D view

Scantlings

Plate thickness [mm], material

- 1.0, VL-36
- 10.0, VL-36
- 11.0, VL-36
- 12.0, VL-36
- 13.0, VL-36
- 14.0, VL-36
- 15.0, VL-36
- 16.0, VL-36
- 5.0, VL-36
- 6.0, VL-36
- 6.0, VL-NS
- 7.0, VL-36
- 7.0, VL-NS
- 8.0, VL-36
- 9.0, VL-36

Clipping planes

☒ Clipping Enabled Reset

From To

#-14+400 X - Longitudinal #274

19000 Y - Transverse -19000

-1000 Z - Height 37000

OCX import

OCX import

OCX import

Messages (177) Output Results

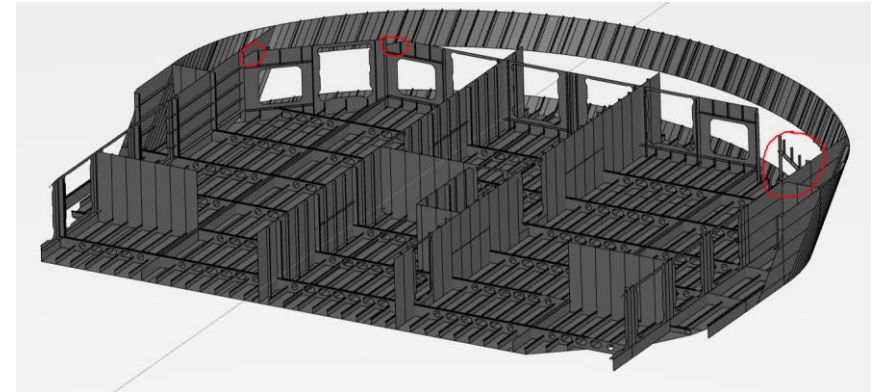
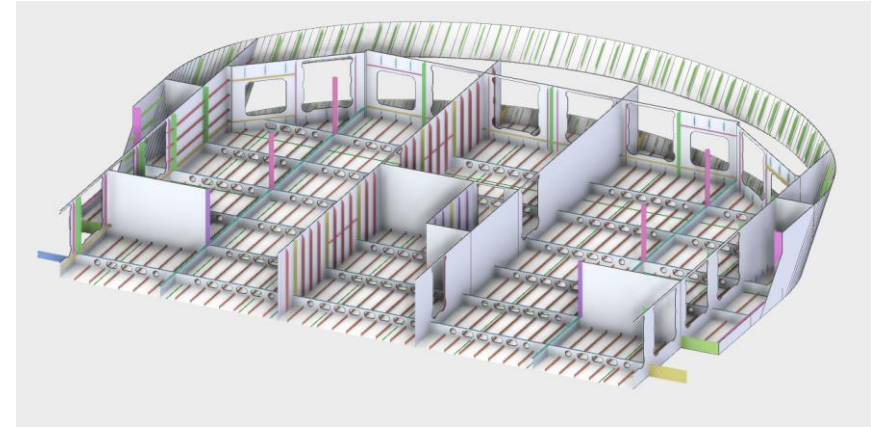
Properties ResultsTree

Nauticus Hull version 20.0 - DevOps version

[OCX import]: Start reading of file: D-ROPAX-2022-OCX-fullmodel.3docx.
[OCX import]: Starting import of OCX model. Supported OCX schema version is 2.8.6
[OCX import]: Starting reading OCX xml data to OCX concept model for vessel id = nplcid1.
[OCX import]: End of reading OCX xml data to OCX concept model for vessel id = nplcid1.
[OCX import]: Starting conversion of OCX concepts to Nauticus Hull concepts for Vessel: (GuidRef = 26b3de5d-25a7-4e5f-a0fc-533a76091812; Id = nplcid1; Name = D-ROPAX-2022/D)
[OCX import]: Closing gaps algorithm applied to curve (Object info not available).
[OCX import]: Virtual panel defined: (GuidRef = 876ef4be-4666-44e3-9c4f-3ff7dc10878b; Id = nplcid8639; Name = SO.Y_1)
[OCX import]: Virtual panel defined: (GuidRef = 1a454215-d11a-44e5-8247-28700937d1d3; Id = nplcid9640; Name = SO.RAMP_PILLARS)

Case study: OCX 3D model transfer possibilities

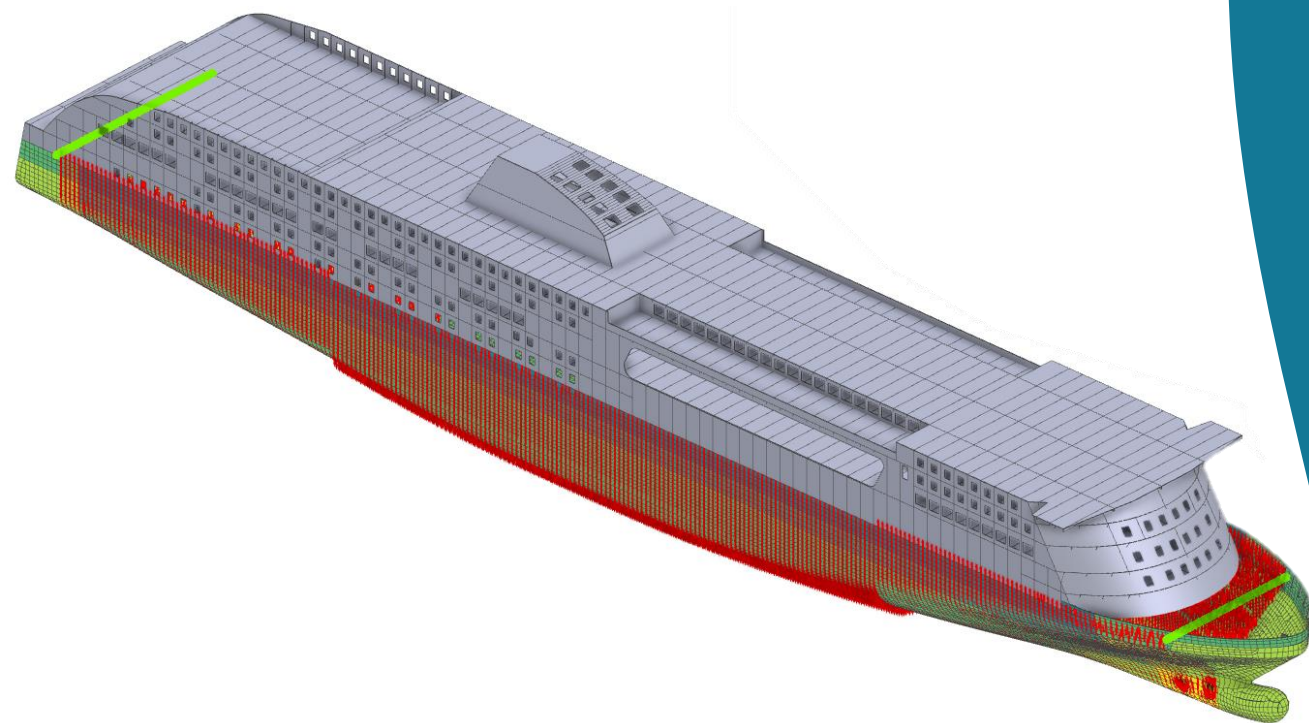
- Piloting OCX as data transfer format between NAPA Steel and Dassault CATIA V6
 - Performed as part of Sami Gusani's master's thesis and compared against other possible transfer approaches
 - OCX Export from NAPA Steel and Import into CATIA V6 using the import tool for CATIA currently being developed by AITAC
 - Test case: Part of Cruise vessel superstructure deck with below structures
- Initial results show good potential in this approach
- Needs for further development identified
 - Improvements for export and import interfaces
 - Some enhancements to OCX schema would be needed



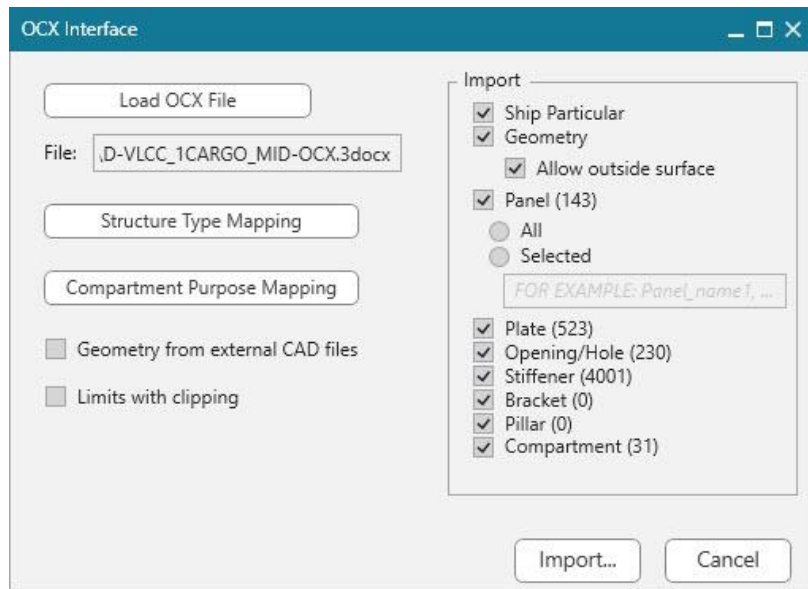
Project courtesy of Meyer Group



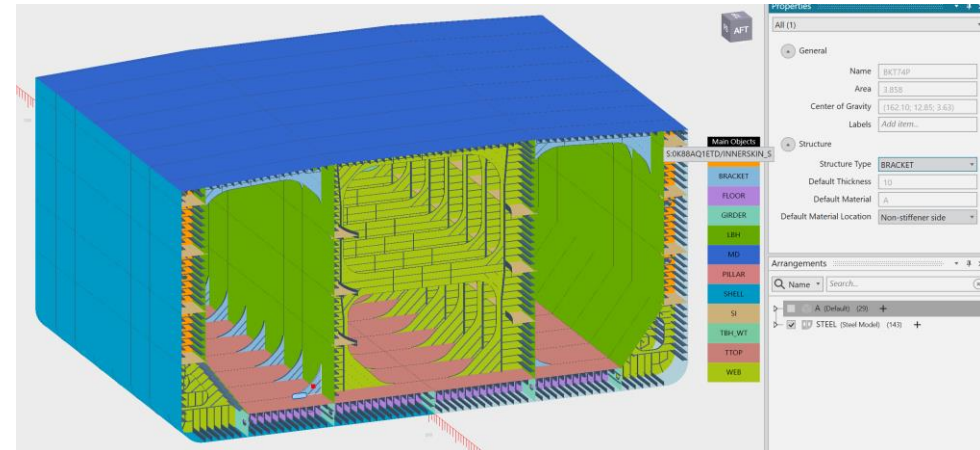
OCX Import / Further Utilizations for 3D MBA



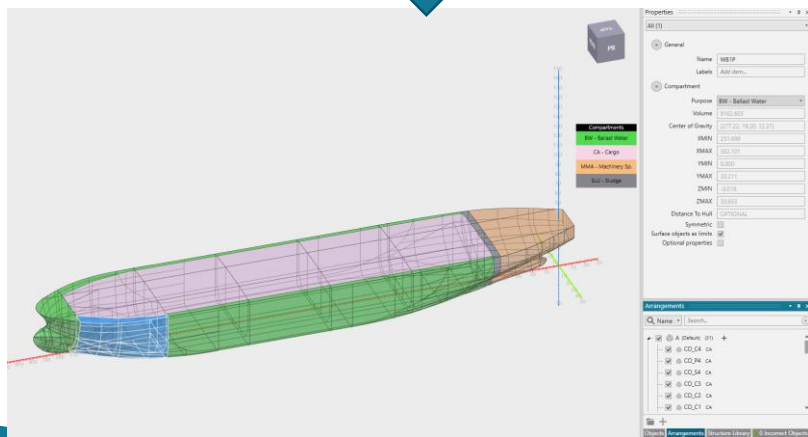
OCX Import to NAPA Designer



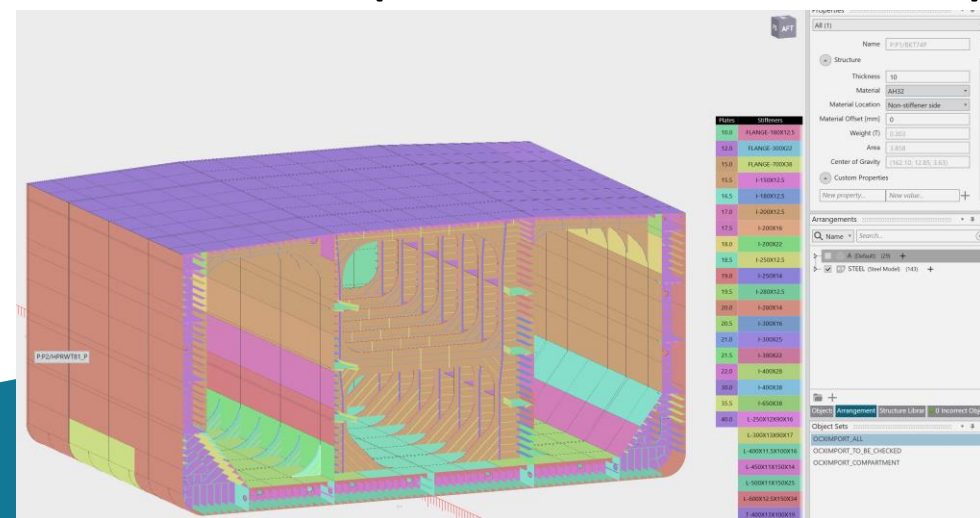
Main Objects



Compartments

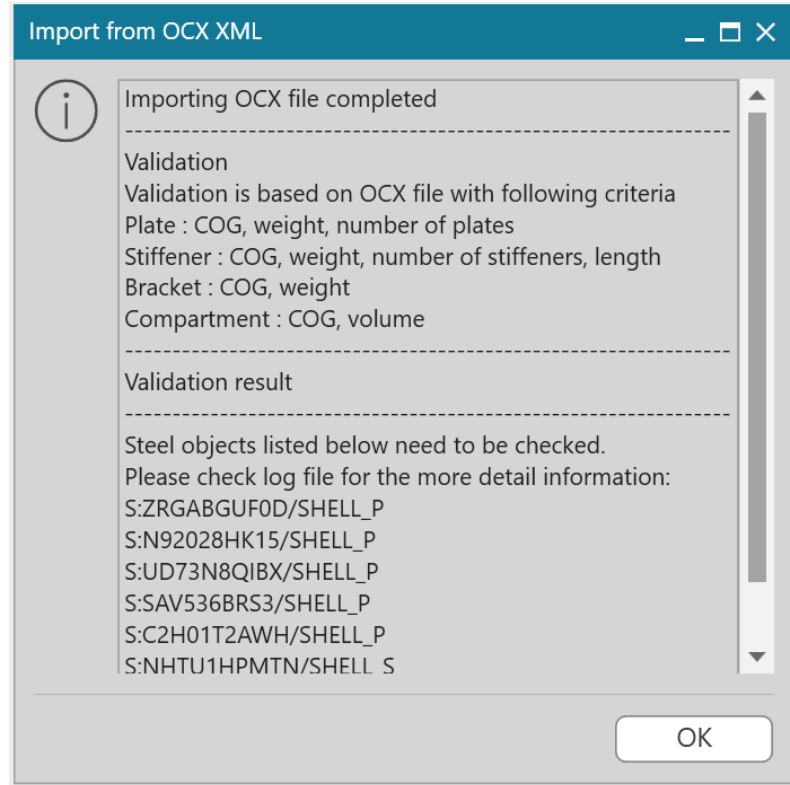


Structural Parts (Plates, Stiffeners, Brackets)

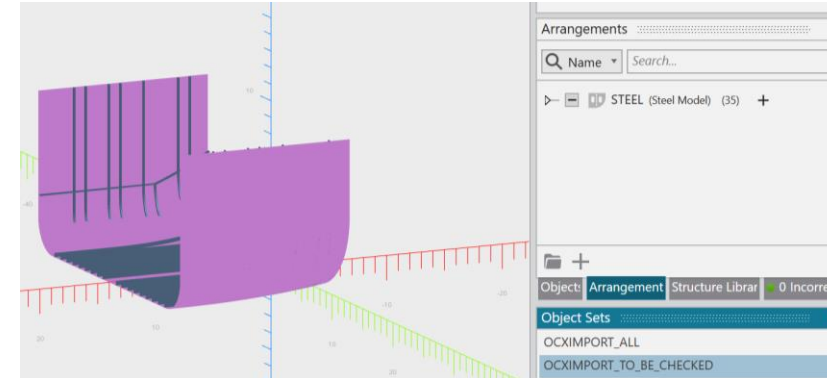


OCX Imported model validation

Import validation summary



Object Set



Import log

```
-----OCX Link-import(02/15/2022 11:56:34)-----  
OCX Schema version : 2.8.6  
Error. HMD has been skipped, INFO: principal particular cannot be set (NaN : 15 : Real expected)  
[Modeling]-S:C3GDACZIGR/SHELL_P, S:WXUCN70YI6/SHELL_P, number of stiffeners S_BMFMZ16SDC_SHELL_P: 1 | Imported: 2  
[Length]-S:C3GDACZIGR/SHELL_P, S:WXUCN70YI6/SHELL_P, S_BMFMZ16SDC_SHELL_P: 8.2105 | imported: 13.3308736803029.  
[C. O. G]-S:C3GDACZIGR/SHELL_P, S:WXUCN70YI6/SHELL_P, S_BMFMZ16SDC_SHELL_P: (3.01; 9.80; 5.50) | imported: (3.60; 9.83; 3.62).  
[Weight]-S:C3GDACZIGR/SHELL_P, S:WXUCN70YI6/SHELL_P, S_BMFMZ16SDC_SHELL_P: 219.1359 kg | imported: 355.801.  
[Modeling]-S:5JPN128AG/SHELL_P, S:1UEX0D7V2W/SHELL_P, S:A4CSDMLUBX/SHELL_P, number of stiffeners S_56ZN2LXWR2_SHELL_P: 1 | Imported: 3  
[C. O. G]-S:5JPN128AG/SHELL_P, S:1UEX0D7V2W/SHELL_P, S:A4CSDMLUBX/SHELL_P, S_56ZN2LXWR2_SHELL_P: (1.51; 9.76; 5.47) | imported: (2.93; 9.78; 3.77).  
[Modeling]-S:YHZNK4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S, number of stiffeners S_BMFMZ16SDC_SHELL_S: 1 | Imported: 2  
[Length]-S:YHZNK4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S, S_BMFMZ16SDC_SHELL_S: 8.2105 | imported: 13.3308736803029.  
[C. O. G]-S:YHZNK4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S, S_BMFMZ16SDC_SHELL_S: (3.01; -9.80; 5.50) | imported: (3.60; -9.83; 3.62).  
[Weight]-S:YHZNK4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S, S_BMFMZ16SDC_SHELL_S: 219.1359 kg | imported: 355.801.  
-----OCX Link-import(02/15/2022 11:56:45)-----  
Time Elapsed: 00:10.685
```

- Before import: schema version, critical errors
- On importing: geometry error, data errors or missing data
- After import: OCX model validation check

OCX Model further utilizations in NAPA Designer

Modeling Changes

Structural drawings

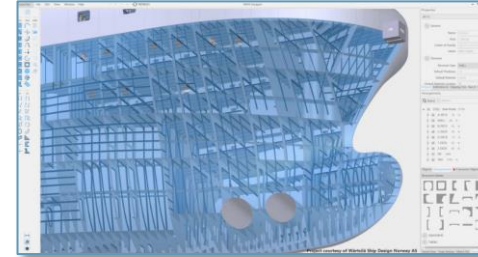
Interfaces to other CAD systems

Interfaces to Class Society rules

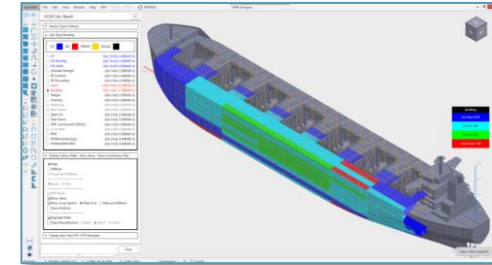
FEM meshing

Web viewer

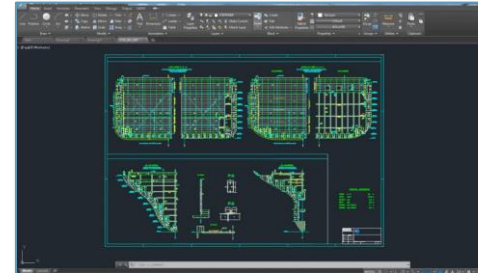
MODELING CHANGE



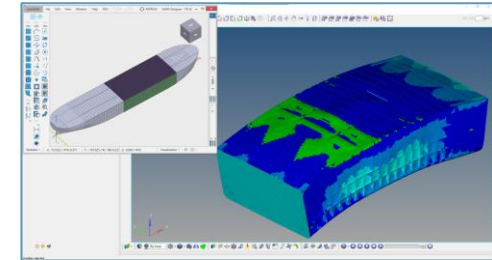
RULE INTERFACES



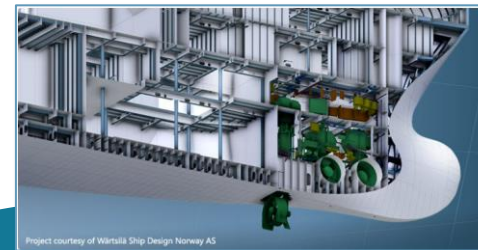
DRAWINGS



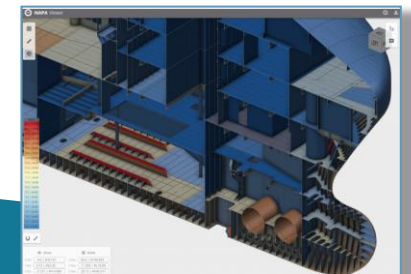
FEM



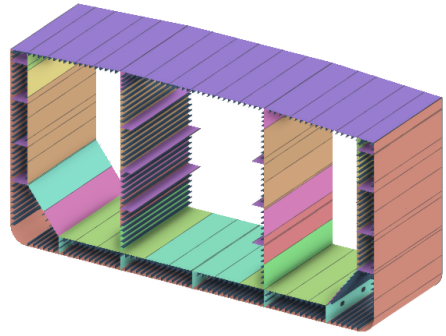
CAD INTERFACES



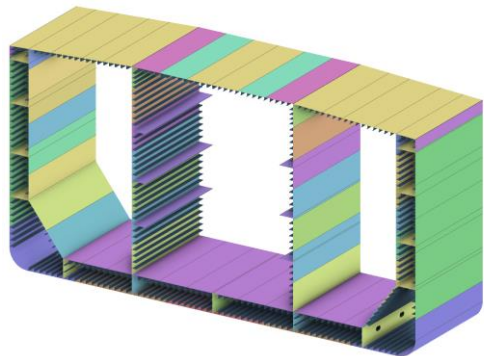
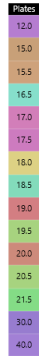
WEB VIEWER



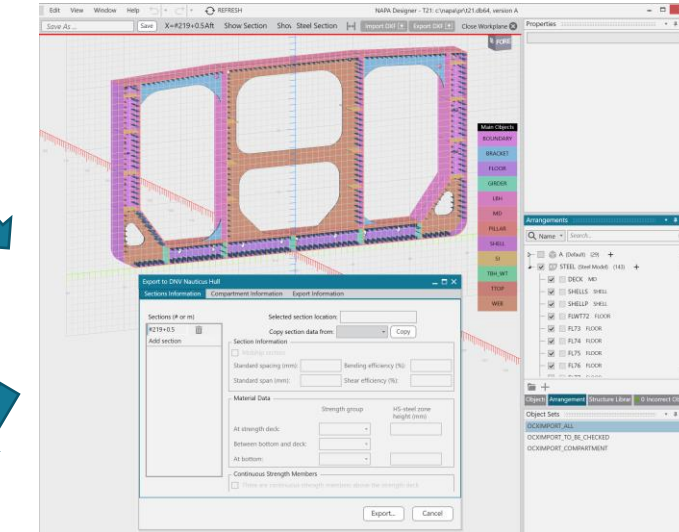
Rule scantling



Initial scantling



Rule scantling



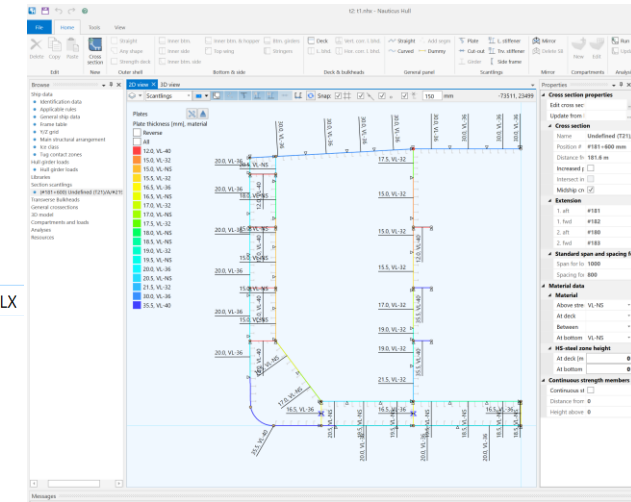
OCX-imported model
Exported to...



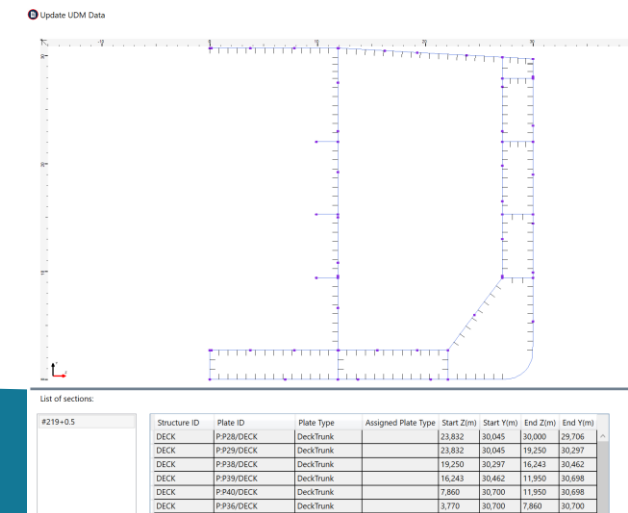
(T21) #219+0.5_HALF.2DLX

T21-ABS.xml

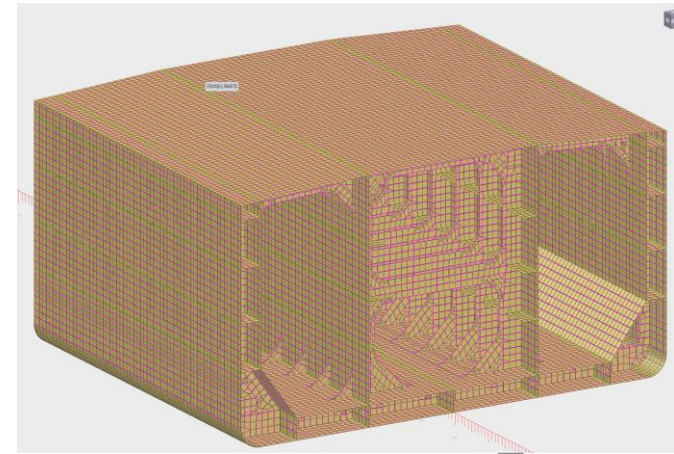
DNV Nauticus Hull



ABS Eagle UDM



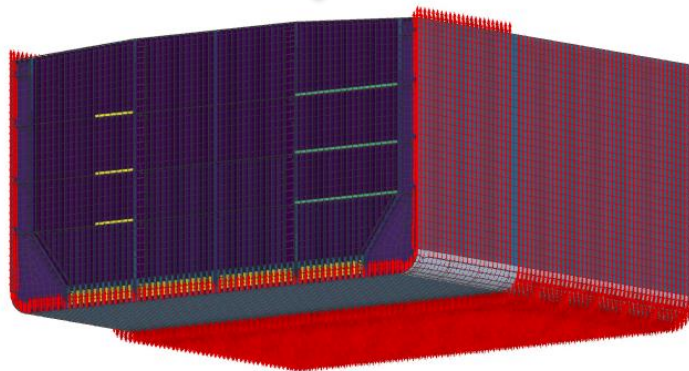
FEM with OCX imported model



FE model creation
from OCX model

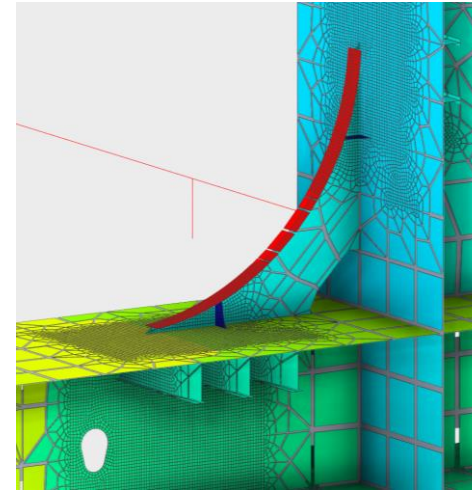
Load

Constraints

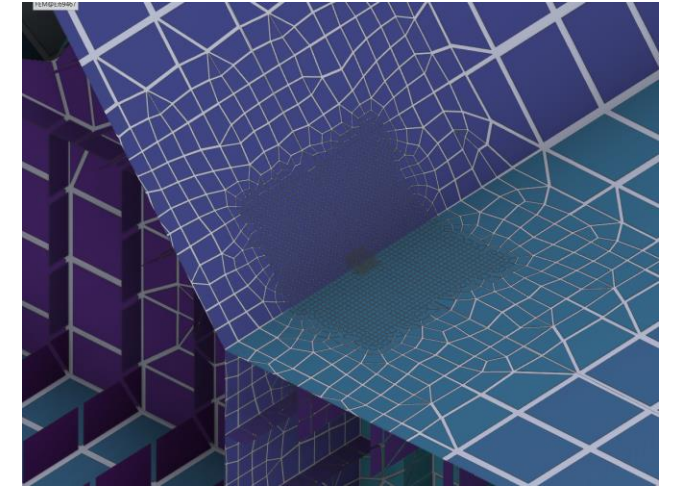


FEA Solvable model

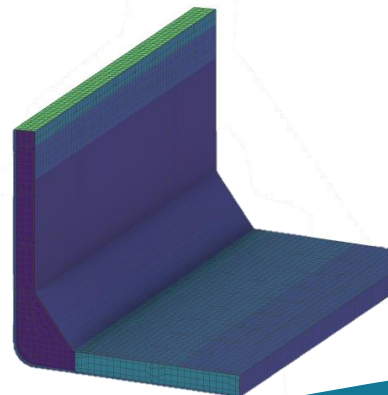
Opening/Bracket toes
with real geometries



Fine-Mesh model for local analysis

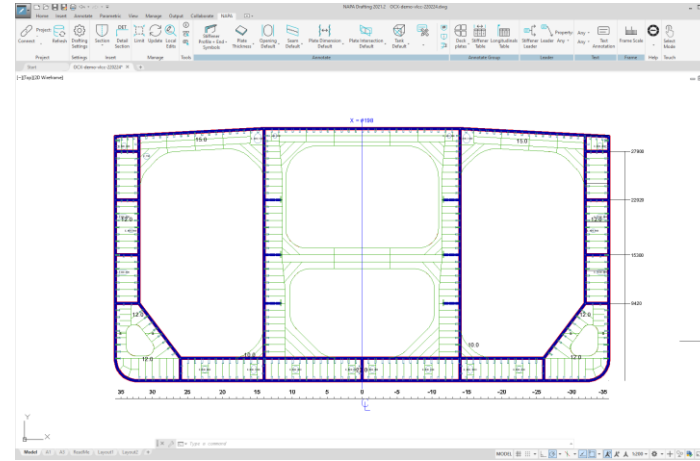
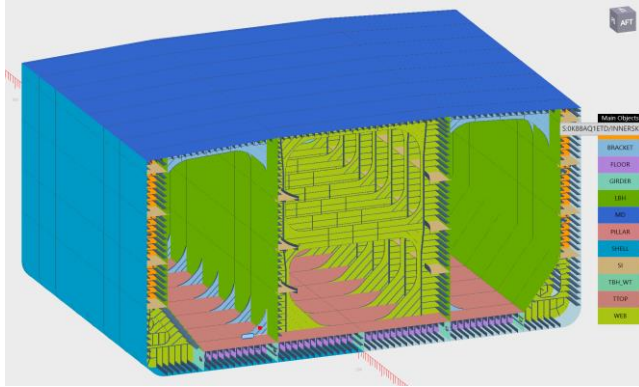


OCX
compartment

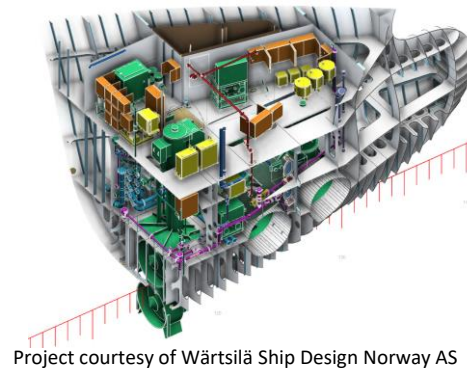


FEM Compartment grouping

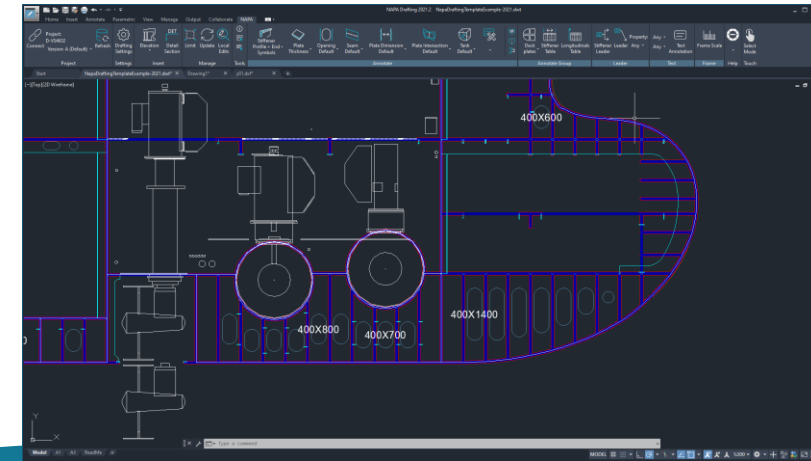
2D Drawing generation



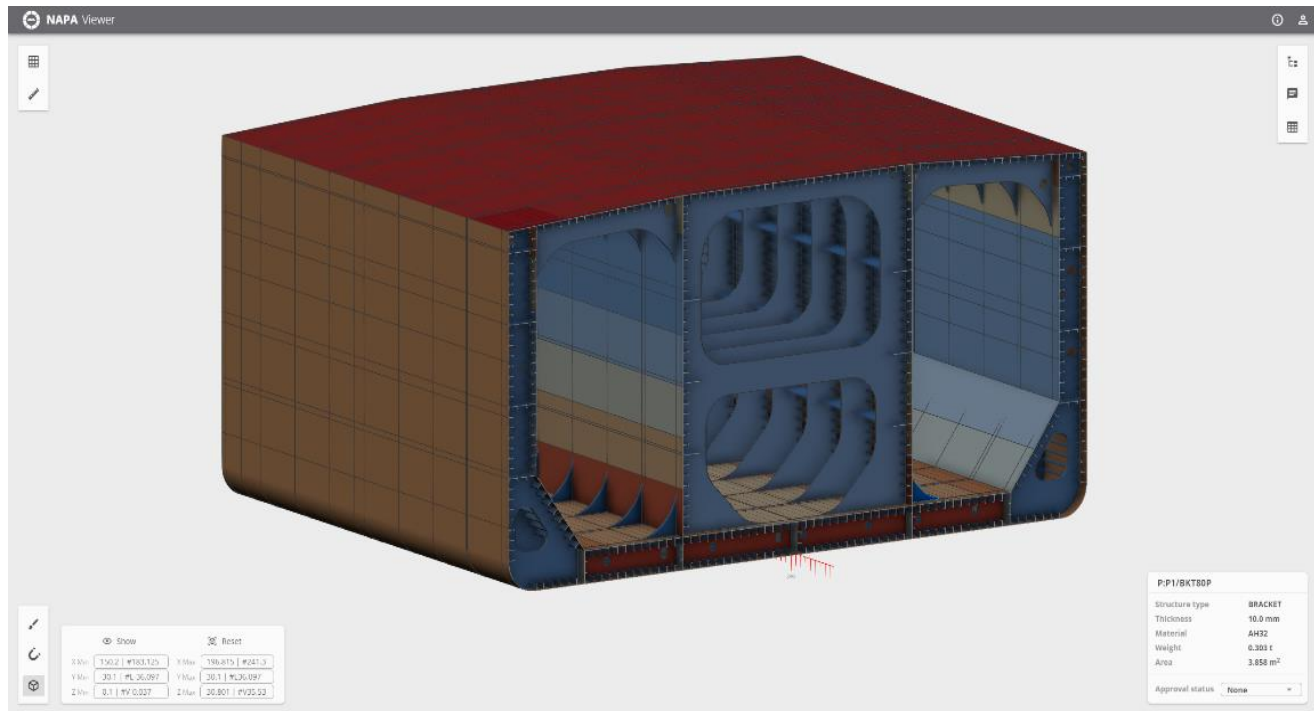
- ✓ 2D drawing is still required as output, archive
- ✓ OCX imported structure model can be accessed in NAPA Drafting
 - 2D Drafting based on AutoCAD
 - Information extraction as annotation and update geometry based on 3D model on 2D drawing by NAPA



Project courtesy of Wärtsilä Ship Design Norway AS



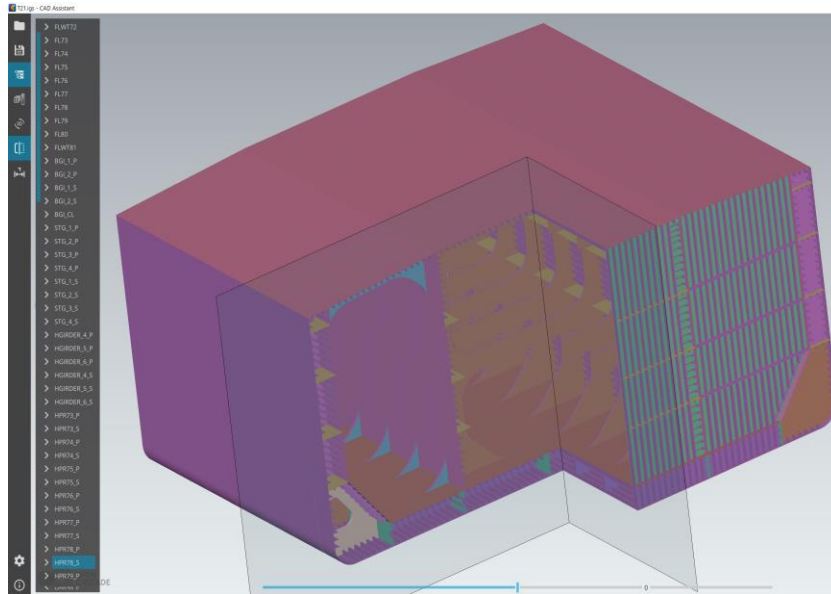
3D model review and information sharing



- ✓ NAPA Viewer: Web viewer
- ✓ Essential data sharing for 3D MBA
- ✓ Access restriction on geometry
(physical file is not shared with)
- ✓ User-specific commenting, with integration to NAPA Designer and in future DNV solutions
- ✓ Cross-section view represented in 2D drawing including annotations
- ✓ Both of structure and compartment model available

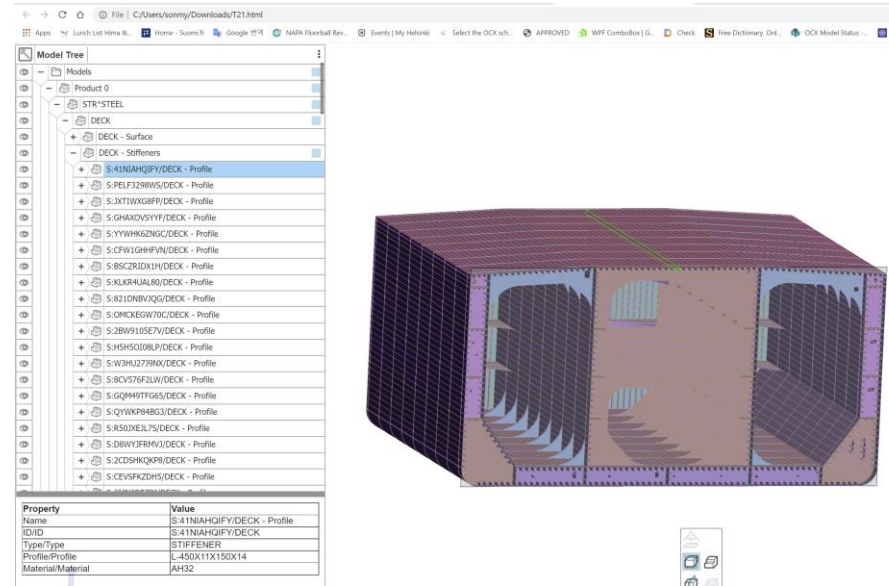
3D model translator

To CAD formats



- ACIS SAT, FBX, IGES, JT, Parasolid (x_t)
PRC, STEP, STL, U3D, VRML, OBJ, 3MF

To publish formats



- 3DPDF, HTML

To downstream
shipbuilding
CAD:

Production Design interfaces



Conclusion

- OCX as **standard format for 3D MBA**
- OCX interface offers benefits by **reusing 3D model**
 - ✓ Rule scantling interface
 - ✓ Rule scantling iteration in design tool
- OCX import, for **further utilizations for 3D MBA**
 - ✓ Rule scantling
 - ✓ FEM
 - ✓ 2D drawings
 - ✓ 3D model review and Information sharing
 - ✓ Model translator
- Future works:
 - ✓ **Commenting interface** between NAPA, DNV
 - ✓ OCX extension : FE loads & constraints, optional design data for file transfer needs





Thank You!

Tapio Seppälä

Product Owner, NAPA Steel

Tapio.seppala@napa.fi